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United States
Department of
Agriculture

Animal and
Plant Health
Inspection Service

Program Aid
Number 1435

Biological Control of Leafy Spurge

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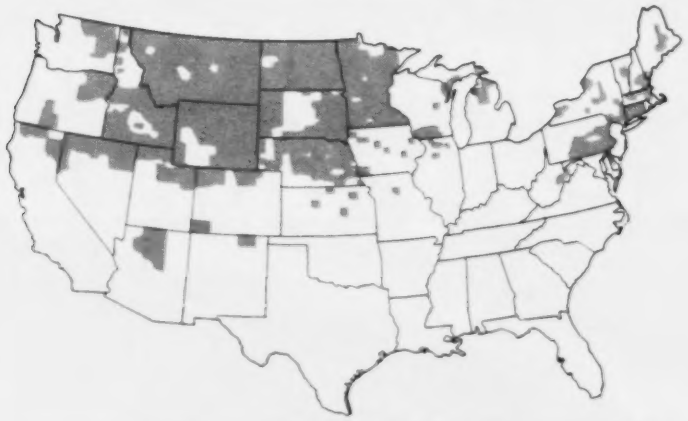


Leafy spurge stands cause heavy damage in the northern Great Plains. Ranchers need to take precautions to limit further spread.

Cattle tend to ignore stands of leafy spurge because chemicals in the weed irritate their digestive tract.

The Problem

Leafy spurge (*Euphorbia esula* L.) has taken over millions of acres of western grazing land. An aggressive, exotic perennial weed, it has greatly reduced the carrying capacity of the range. It readily outcompetes desirable native vegetation. Because of irritating chemicals in the weed, cattle and horses generally don't graze on it, and they even avoid nutritious forage growing nearby. The damage costs ranchers an estimated $35 to $45 million per year.

Herbicides have been used against leafy spurge, but infested acreage is so extensive that chemical control isn't practical. For one thing, herbicides sprayed to kill spurge also kill desirable broad-leaved range plants.

Secondly, chemical control is expensive. A 1984 study by the University of Wyoming put the cost of applying herbicides at $72 per acre. Costs of spraying outweigh the benefits by as much as 10 to 1.

Furthermore, the weed is hard to kill with chemicals. It has a pervasive root system and seems to be able to block the downward movement of herbicides.

To bypass these difficulties, the U.S. Department of Agriculture is coordinating a major biological control program that

involves importing and distributing the weed's natural enemies. Biological control specialists in USDA's Animal and Plant Health Inspection Service are concentrating on insects that have evolved to feed only on the target weed, leafy spurge. Collectively, the feeding insects inhibit the weed's growth and reproduction and reduce its ability to compete with desirable range plants.

Spurge infestations can be quite attractive to the eye. Only when it comes to economics does the plant take on an ugly cast.

The Weed—A Description

Leafy spurge grows in dense clumps with one or more shoots coming from a woody root crown. A milky latex seeps from the plant when it is cut or torn. Its nonwoody, hairless stems, which can reach 3 feet or more in height, hold alternate, usually pointed leaves. In summer, the weed develops a cluster of yellow flowers with large, round, greenish-yellow bracts.

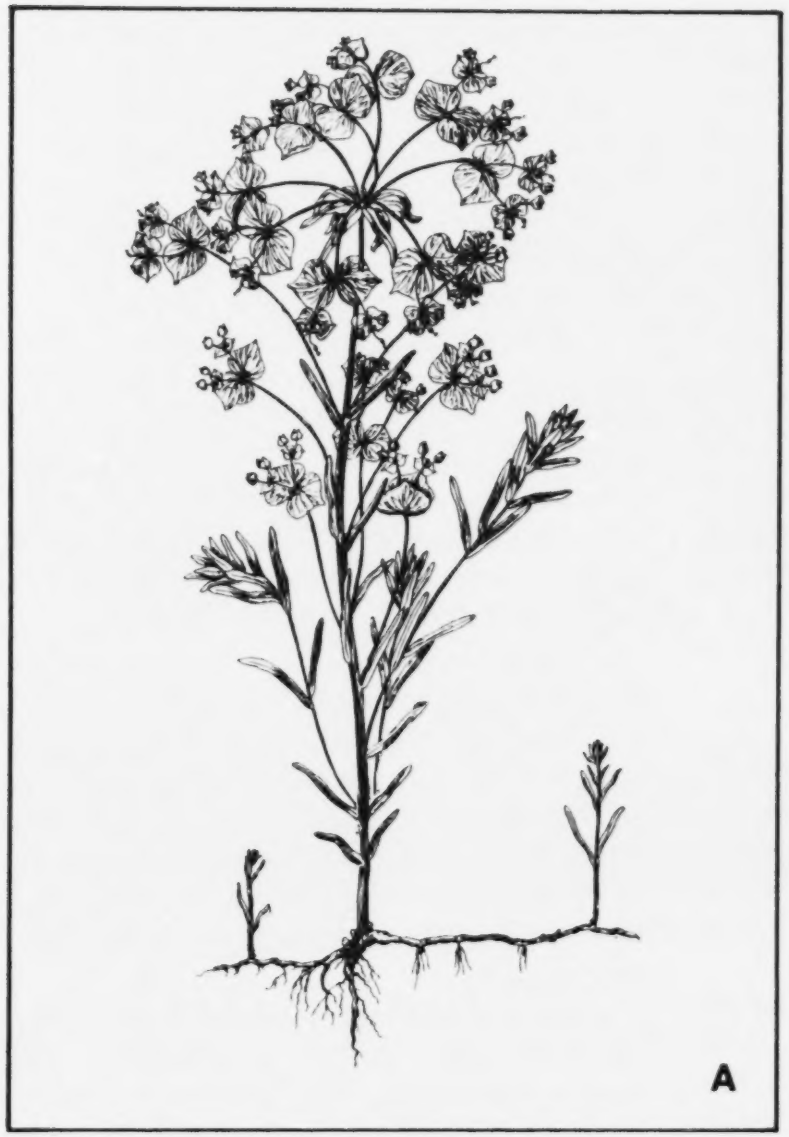
Seeds grow inside a three-valved capsule. When the seed is ripe, the capsule bursts, shooting seeds up to 15 feet from the plant. Waterways and animals carry the seed further. Most of the seed germinates the first year, but a portion can germinate up to 7 years later.

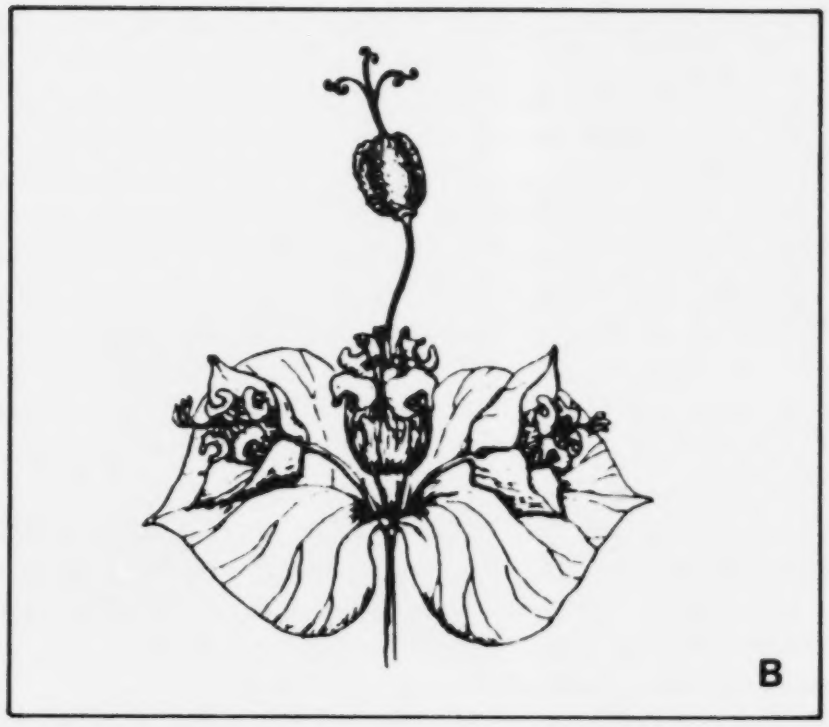
The roots of spurge, which can descend 14 feet, help it crowd out neighboring species and store a large food reserve. Pink buds on the root crown sprout readily and produce new shoots, adding to the weed's rapid spread.

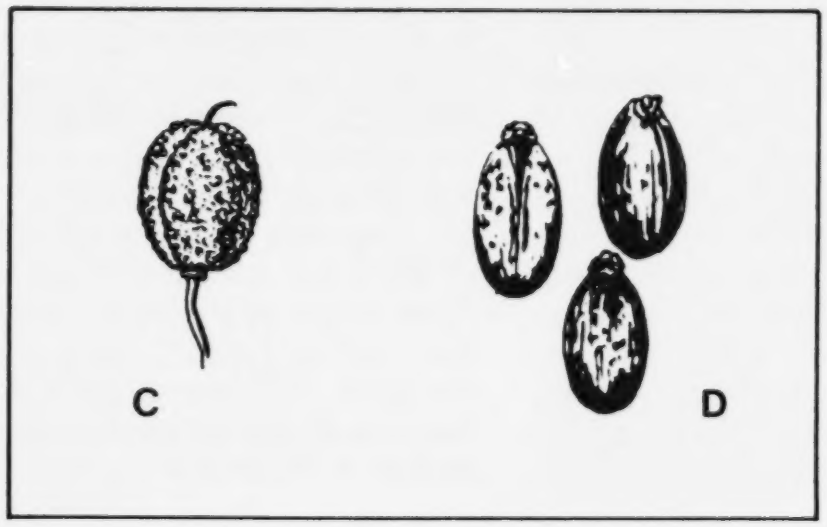
The first record of its introduction in North America places leafy spurge at Newbury, Mass., in 1827. By the early 1900's, the weed had been carried into the Western United States and Canada. Today, leafy spurge occupies more than 2½ million acres. It is concentrated most heavily in the northern Great Plains, particularly in North Dakota.

Above: The root crown of spurge has adventitious buds that can sprout readily and produce new shoots, adding to the weed's rapid spread.

Left: Spurge plants can grow to be waist high. They bear pointed leaves and a cluster of yellow flowers with large, round, greenish-yellow bracts.







Leafy spurge. Above (A), habit. Top Right (B), flower cluster. Bottom Right (C), capsule and (D) seeds.

Biological Control

In Europe and Asia, enough natural enemies have developed over time to control leafy spurge without human help. Insects and diseases in the Old World have put such stress on spurge that it remains an insignificant component of the landscape.

The weed's natural enemies do not occur in the New World, because of its relatively recent introduction.

To achieve biological control, human beings needed to intervene. Small numbers of beneficial organisms that attack leafy spurge have been released in America in the past with limited success. The critical difference between earlier efforts and the current program coordinated by USDA's Animal and Plant Health Inspection Service is one of scale.

APHIS biological control specialists believe that increasing the numbers of beneficial insects released over an extensive area will do better than the modest introductions of the past. The project depends on a broad, coordinated effort with cooperation from many Federal, State, and industry groups.

To start with, USDA officials already have cleared five species of insects from Europe for release in the United States. Together, these spurge enemies make a good team for fighting leafy spurge because they attack different parts of the plant. Some feed on the leaves. Others attack the shoot tips. Still others feed on the stem, the root crown, and the deep secondary roots. Each attack weakens the plant in a different way, thereby exerting a cumulative stress on the weed.

Scientists in USDA's Agricultural Research Service (ARS) are scouting out and evaluating other biological control agents for distribution in North America. Eventually, they hope that there will be enough spurge enemies in North America to achieve the same level of control enjoyed in Europe.

Stem and Root Boring Beetle

The first of the five introduced insects is a cerambyciid long-horned beetle, *Oberea erythrocephala* Schrank, which was brought in from Hungary and Italy. Females lay an average of 60 eggs and live between 3 and 8 weeks.

The adult beetle feeds on the outside of the plant and girdles the stem. The larval stage of the insect bores into the stem and root crown, feeding from inside the plant. The overall effect is to reduce the carbohydrate reserves stored in the roots.

Root Mining Flea Beetles

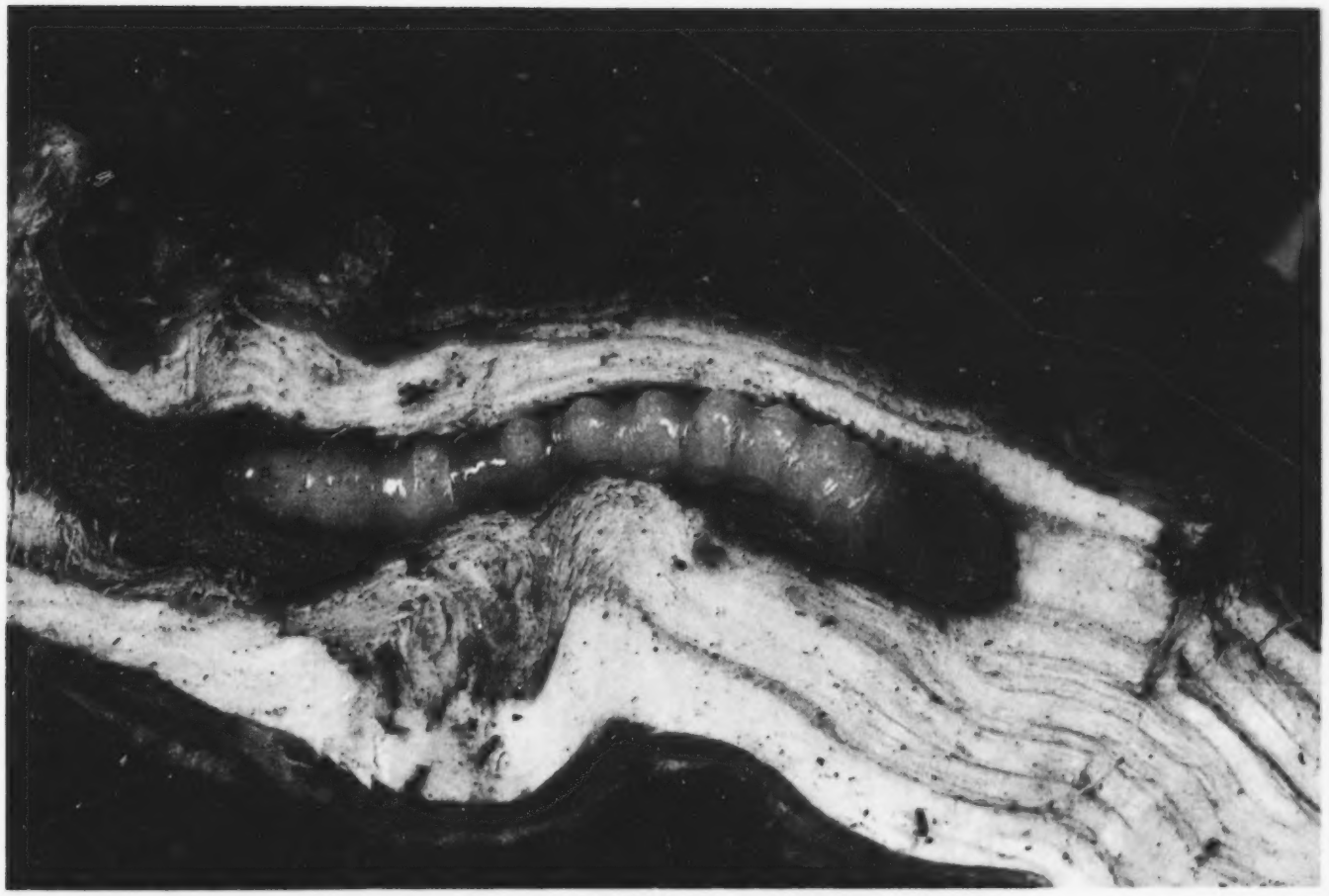
Three species of chrysomelid flea beetles, *Aphthona flava* Guill., *Aphthona cyparissiae* (Koch), and *Aphthona czwalinae* (Weise), contribute to the attack on leafy spurge. They were brought to the United States from Austria, Hungary, Italy, and Yugoslavia.

Adults of the three flea beetles live up to 3 months and feed on the leaves of the weed. They lay their eggs on spurge stems, about 250 eggs per female. The larvae cause even more damage to spurge, mining the primary and secondary roots as well as the fine root hairs, thereby disrupting the plant's vascular tissues.

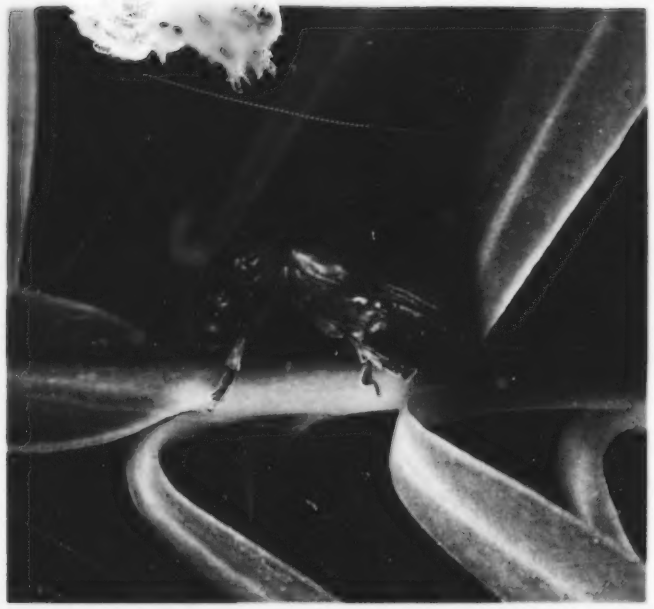
Shoot-tip Gall Midge

This cecidomyiid midge, *Bayeria* sp., is a tiny fly imported from Italy. Female adults, which live only 24 to 36 hours, lay an average of 73 eggs on the shoots of leafy spurge. The species can produce three to five generations in a single growing season.

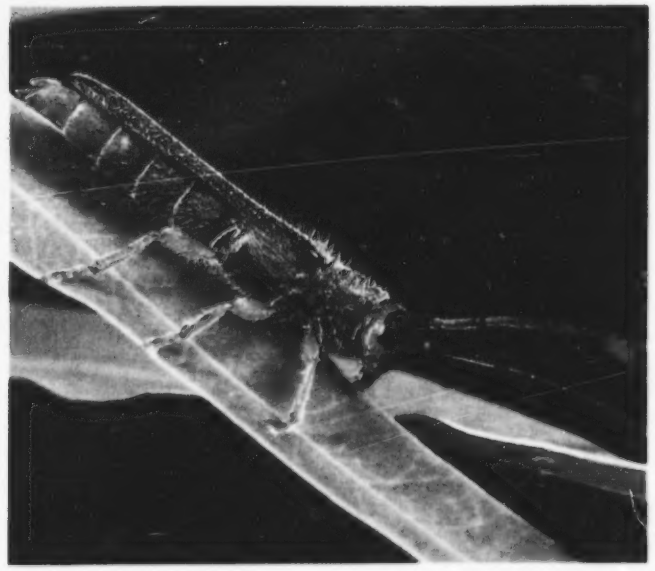
Larvae feed on the shoots and stimulate the plant to form a tumor-like gall on the shoot tips. This gall keeps shoots from forming flowers or seeds and reduces energy reserves of the weed.



Larvae of long-horned beetles bore the stem and root crown.



Adult flea beetles feed on the leaves of spurge.



Adult long-horned beetles from Hungary and Italy girdle the stems of spurge and feed on the leaves.

Larvae of flea beetles damage spurge by mining the primary and secondary roots as well as the fine root hairs.

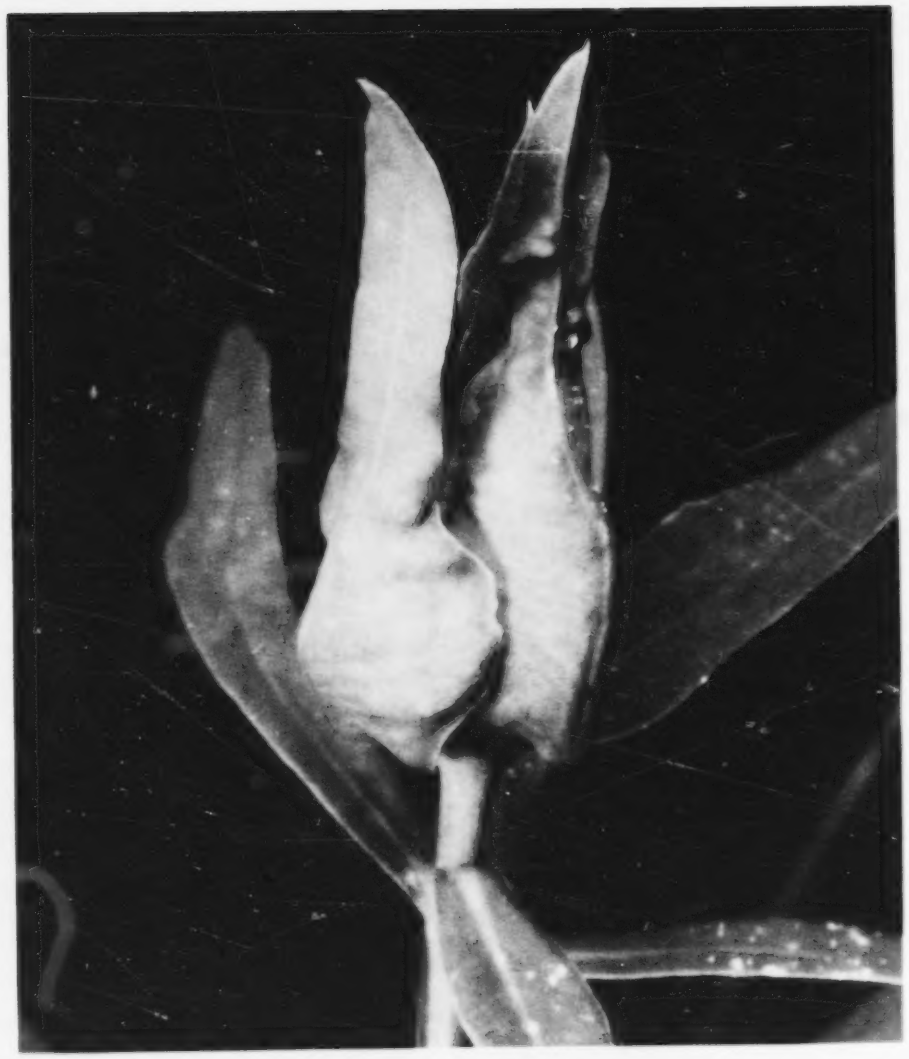
The shoot-tip gall midge can produce three to five generations in a single growing season.

Establishing Exotic Insects

The five natural enemies of leafy spurge now being released in North America were examined in test plots in Europe and evaluated in quarantine stations in the United States by ARS scientists. They made sure that insects intended for export were healthy, so that they could spread in North America free of diseases and parasites.

Furthermore, the scientists made sure that the new insects would be safe for release in the United States. Stringent import rules prevent introducing foreign organisms that can damage desirable plants.

The ARS scientists checked whether the insects would attack crop and pasture plants, including corn and alfalfa. They also studied the insects' behavior toward North American wild plants that are closely related to leafy spurge. Leafy spurge has seven relatives so rare that they are listed as endangered or threatened, or are under consideration for that status. Tests showed that the five natural enemies of spurge are highly selective in their diet and don't attack commercially grown plants or desirable wild spurge relatives.

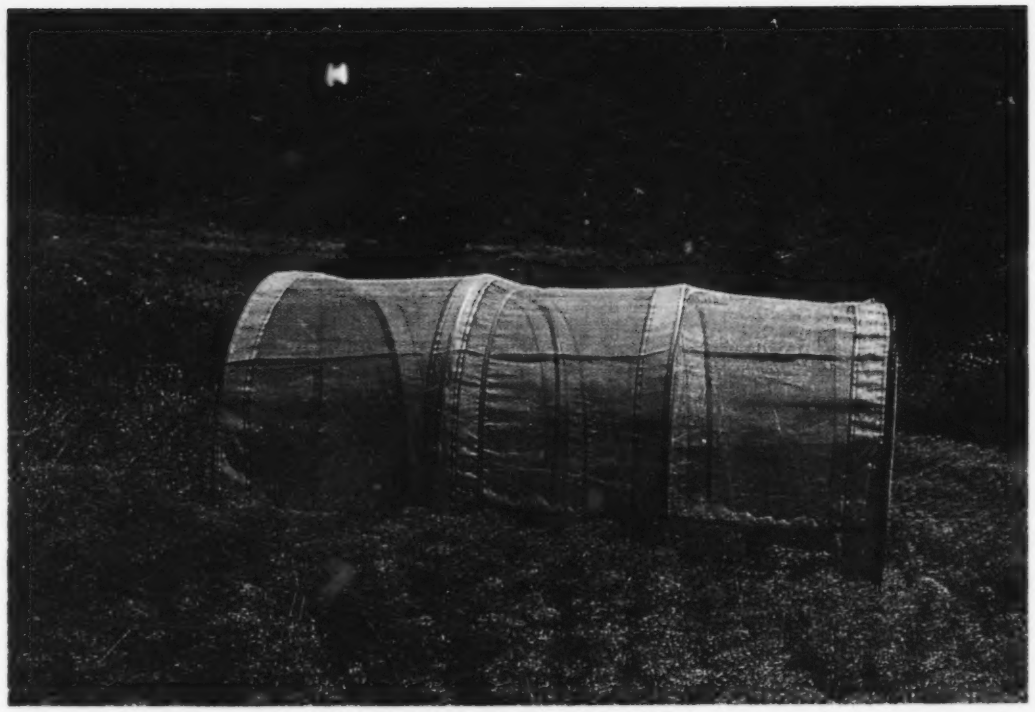


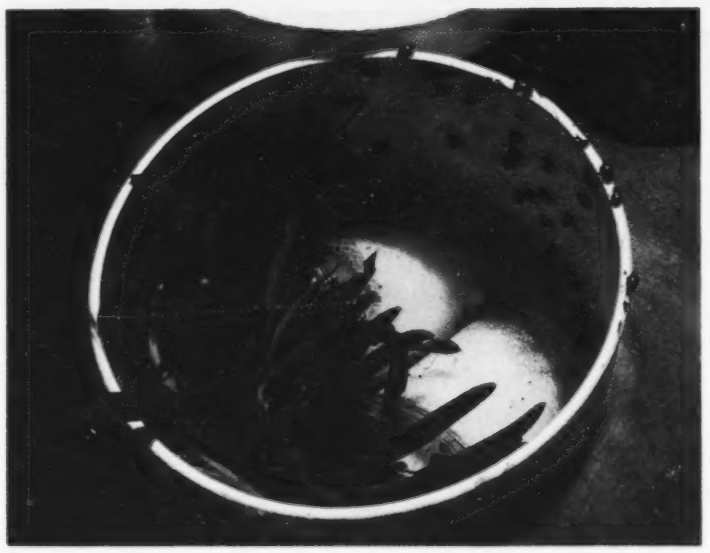
A tumor-like gall, induced on the shoot tips of spurge by midge larvae, retards formation of flowers and seeds.

After having carefully screened the five leafy spurge enemies, biological control specialists in the Animal and Plant Health Inspection Service faced the challenge of securing a large enough supply of each species to release on the range. The specialists developed ways to mass rear some of them in the laboratory. Other insects proved better suited to having their numbers multiplied in the field.

Field rearing is done in field insectaries, which are small plots of land, generally about 10 acres, infested with leafy spurge. There, the insects are released and protected, so that they can grow and multiply with minimum stress.

State cooperators collect offspring of the released insects to place in satellite insectaries in other locations around the State. The insects also disperse naturally.





Above: Leafy spurge enemies often are placed in protective field cages to help them become established.

Flea beetles can be mass reared and sent to the field in shipping cartons.

What Ranchers Can Do

Ranchers need to be patient in awaiting the benefits from introduced leafy spurge enemies. Some beneficial insects already are at work on the range, but no dramatic results have been observed because biological control is a gradual process. Ranchers can help the process by restricting their use of herbicides and insecticides at and near release sites so that the insects can multiply without harm from agricultural chemicals. Still, it takes several years to build up adequate numbers of a weed's natural enemies at any specific location. When the insects increase in number and spurge becomes less abundant, the natural enemies search for other stands of the weed to attack. They continue the process for as long as spurge is present.

While awaiting the arrival of the insects, ranchers also can help by being careful not to spread spurge into new areas. Spurge has been spread over and over by people who were not aware that they were doing any harm. The seed travels along unobtrusively in hay and as a contaminant of forage seed and grain. Hay contaminated with spurge should not be moved. Cultivating equipment and trucks should be checked before being moved to make sure that the weed has been cleared away.

Ranchers also can make interim use of less exotic "natural enemies." Sheep and goats grazing on spurge-infested land feed on the weed's flowers, thereby reducing seed production. Sheep can safely satisfy half of their diet or more from spurge despite the noxious chemicals in the weed. Even ranchers who traditionally have run only cattle should consider stocking sheep if they have an extensive spurge infestation.

Ranchers can help defeat leafy spurge by retarding its spread and by managing the range so as to promote the weed's natural enemies.

Cover: Male and female long-horned beetles, mating on leafy spurge, produce offspring that first feed on the inside, then on the outside of the weed.

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